



Division of Agricultural Sciences
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Pruning Deciduous Fruit Trees

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Pruning means removing certain parts of the tree in order to modify and utilize its natural habits so that more and better fruit can be obtained at less cost and over a longer period.

Warren P. Tufts

Wise pruning practices will help secure . . .

- Vigorous, mechanically strong, healthy trees
- Trees well shaped for convenience and economy in orchard management
- Distribution of the fruiting area well over the individual tree
- Fruit of good size and quality
- A succession of profitable crops

This circular discusses . . .

- Pruning responses
- Training systems
- Training the young nonbearing tree
- Pruning the bearing tree

In many counties . . .

farm advisors have established demonstration plots showing the results to be obtained under local conditions with the training and pruning methods discussed in this circular.

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GROWTH AND PRODUCTION . . .

what the tree needs for normal development; how pruning and other cultural practices can aid growth and fruitfulness.

PAGE

6

PRUNING RESPONSES . . .

the timing and severity of pruning are important in the development and productivity of fruit trees.

PAGE

10

TRAINING SYSTEMS . . .

the shape of the tree and arrangement of its framework branches are determined by training systems applied to the young tree. There are three basic systems.

PAGE

16

THE YOUNG NONBEARING TREE . . .

proper pruning will help bring fruit trees into profitable bearing at an early age. General recommendations are outlined here as well as specific practices for various types of trees.

PAGE

21

THE BEARING TREE . . .

each year a certain amount of pruning is needed to insure a constant renewal of fruit wood. Here are the general principles involved and suggestions for handling specific trees.

PAGE

30

FOR A BETTER UNDERSTANDING . . .

Here are definitions of the terms used in this circular

Alternate bearing: alternate heavier and lighter crops of flowers and/or fruits are produced in successive years. The degree may vary widely. In some cases only small differences occur; in others a very heavy crop of fruit may be followed by a complete failure to form flower buds for the next year.

Basin crotch or water pocket: the depression formed by the growth of three or more scaffolds at the same level on the trunk.

Bulk pruning: only relatively large limbs are removed and relatively few cuts made per tree. This is in contrast to fine pruning (see below).

Bud: an unexpanded flower or vegetative shoot generally protected by bud-scales.

Leaf or shoot bud: a bud containing the unexpanded leaves and growing point of a vegetative shoot.

Flower or fruit bud: a bud containing the unexpanded parts of a single flower (peach, apricot, almond) or one to several flowers (cherry, plum).

Mixed bud: a bud containing both undeveloped flowers and leafy shoots (apple, pear).

Lateral bud: a bud on the side of a shoot or spur.

Axillary bud: a lateral bud that occurs in the axil of a leaf (the angle formed by a leafstalk and a shoot).

Terminal bud: a bud on the end of a shoot or spur.

Latent or trace bud: a bud that grows only enough after its formation that its

THINNING OUT



Apple branches with one-year shoots: Left, thinned out 50 per cent; Right, thinned out two-thirds.

HEADING BACK



Apple branches with one-year shoots: Left, headed back 50 per cent; Right, headed back two-thirds.

growing point remains at or near the surface of the plant. Practically all new growth arising from older branches and trunks of trees comes from latent rather than from adventitious buds.

Adventitious bud: a bud arising at an unusual point other than a leaf axil or the end of a shoot or spur. Such buds may arise on a root, trunk, branch, or shoot.

Fine pruning: many cuts are made in the small shoot and spur growths. This is in contrast to bulk pruning (see above).

Framework: the basic branch structure of a tree which gives it its shape and strength.

Hanger: a branch growing downward from a scaffold limb.

Head: that part of the trunk from which the scaffold branches arise.

Heading or heading-back: cutting to a stub, a lateral bud, or a lateral branch so small that the new growth comes from one or two buds near the cut and is vigorous while the lower buds remain latent. **Thinning-out** is the removal of lateral branches at their point of origin or reducing the length of a branch by cutting to a lateral large enough that it tends to assume the terminal role and the new growth is modified accordingly. The response to thinning-out is opposite to that characteristic of heading-back.

Height of head: the distance between the ground and the lowest scaffold limb.

Lateral or lateral branch: a limb or shoot arising from another by growth of a lateral bud.

Scaffold: one of several limbs making up the framework of a tree and supporting the fruiting branches. A primary scaffold arises from the trunk of a tree. A secondary

scaffold arises from a primary scaffold limb.

Shoot: a stem with its leaves. During the growing season, a shoot may be referred to as current season's or this year's growth.

One-year-old shoot or wood: term used after leaf fall and during the following growing season to designate shoot or spur growth that developed during the previous growing season.

Two-year-old wood: growth one year older than one-year-old wood. A similar method of designation may be used for older branches.

Spur: a short shoot, normally growing less than 4 inches in any given season. Most spurs are formed from lateral buds.

Spur pruning: essentially a fine pruning (see above), in which whole spurs or portions of spurs are removed.

Sucker: a vigorous shoot arising below the ground from the trunk or roots.

Thinning out: see heading or heading-back, above.

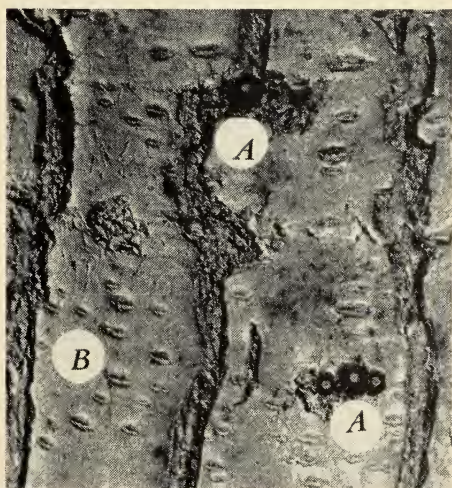
Training: directing the growth of a young tree to secure the desired shape and arrangement of framework branches.

Water sprout: a vigorous shoot arising above the ground from the trunk or older branches. These originate primarily from latent buds.

Water pocket: see basin crotch or water pocket, above.

LATENT BUDS

Latent buds on an old apricot branch are shown at A. These must not be confused with lenticels (small openings in the bark which permit the passage of air), B.



PRUNING DECIDUOUS FRUIT TREES

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GROWTH AND PRODUCTION . . .

what the tree needs for normal development; how pruning and other cultural practices can aid growth and fruitfulness.

Plant food supplies: their source and use

A tree so responds to any kind of pruning that if its form is modified, its functions are influenced. To produce the desired responses, it is necessary to understand not only the various pruning operations but also the nature of the tree's responses to cutting. Certain facts concerning the tree's annual cycle of growth and development are basic to the adoption of sound pruning practices.

The first growth of the season (blossoms, leaves, and new shoots) is made largely at the expense of plant-food reserves normally stored in the tree during the preceding summer and fall. These stored foods are thus at least partially used up early in the spring.

Carbohydrates, a most important class of foods for both plants and animals, are manufactured by plant leaves from carbon dioxide supplied by the air and from water supplied by the soil. In this process, light and chlorophyll (the green coloring matter of leaves) are necessary. The complex materials needed for growth and development are synthesized from the minerals supplied by the soil and from the carbohydrates of the leaves.

After the active vegetative period of early spring, the plant begins to store the synthesized foods that are not used in the maturing of the current fruit crop, the development of leaves, the extension of the top and roots, and the development of fruit buds for the succeeding year's

crop. Under favorable conditions, the storage of reserves for the winter months and the following year's growth becomes greater and greater as the season advances until near the time of leaf fall.

Food supplies can be regulated

A fruit tree with its crop represents an accumulation of materials drawn from the soil by the roots and from the air by the leaves. When materials from either source can no longer be obtained, the tree ceases to live. Consequently, any plan for developing and managing an orchard from its planting to the time it is no longer profitable must include the treatment of both soil and tree.

Trees develop or produce differently in different locations and respond rather readily to cultural practices, especially pruning. The relative abundance of the various food materials must be considered. Plants respond differently in growth and fruit production according to amounts of nitrogen available, amounts of carbohydrates that can be manufactured, and the manner in which these are combined within the plant.

One way of varying the relative abundance of foods is to change the top by pruning. Top pruning necessarily reduces both the present and potential growing points and leaf area, usually with the following effects:

1. The food supply is decreased by reduction of the manufacturing surface.
2. A greater percentage of reserve

foods is made available to the reduced number of growing points and fruits.

3. A decreased evaporation results in conservation of soil moisture and allows a smaller tree to thrive longer under conditions where water is limited.

4. Root growth is decreased by a reduction in the amount of energy-producing food manufactured.

Great differences may also be brought about by variations in temperature, in the length of the light period to which plants are exposed, and in the presence or absence of certain mineral elements.

Four classes of growth and fruit response

In fruit trees, the factors most likely to occur in limited amounts are carbohydrates, nitrogen, and water. Four general classes, based on the availability of carbohydrates and nitrogen, may be set up to describe the states of vegetativeness and fruitfulness in the plant. They present a working concept of the tree's response, without necessarily indicating the cause of the response.

1. When mineral nutrients (including nitrates) are abundant but little or no carbohydrate supply is available, the result is weak vegetative growth and a nonfruitful plant.

2. When mineral nutrients (including nitrates) are abundant and a carbohydrate supply is available, the result is strong vegetative growth but little or no fruit.

3. When mineral nutrients are abundant (except nitrates, which are relatively less than in class 2), vegetativeness is reduced and carbohydrates accumulate, resulting in fruitfulness and a moderate amount of vegetative growth.

4. When mineral nutrients are abundant (except nitrates, which are rela-

tively even less than in class 3), the result is a marked accumulation of carbohydrates and a suppression of both vegetativeness and fruitfulness.

Naturally, these classes grade into each other, but trees can be classified quite accurately by their appearance and performance, plus knowledge of the general cultural conditions. The crops produced and the new wood growth made generally furnish an excellent basis for judgment and a fairly accurate estimate as to what is happening in the plant.

How pruning affects growth and fruitfulness

Heavy cutting, whether on young trees or old, generally results in rank vegetative growth and, with trees of bearing age, in reduction of fruitfulness. If, in addition to the pruning, the trees are irrigated and heavily fertilized, the new growth will be still ranker and more succulent, and little or no fruit will be produced (class 2, above).

In bearing trees, on the other hand, a lack of pruning, soil moisture, and nitrogen will result in scanty new wood growth and in a tendency toward overproduction. If this treatment is continued, trees soon reach a condition where little or no wood or fruit is produced (class 4, above). Between these two extremes may be found all gradations of vegetativeness and fruitfulness.

Unfortunately, many attempts have been made in the past to influence the wood growth and the productiveness of the tree by pruning alone. This is a mistake, since pruning is only one of the factors modifying plant growth and productiveness. Irrigation, application of fertilizers, and cultivation (which kills



Fruit and leaf buds on:

Apricot

The fruit spur on the left is two years old, that on the right, one year. Bud scale scars are shown at W; scars where fruits have been produced at X; fruit buds at Y; leaf buds at Z.



Plum

Fruit spurs are, left to right: Robe de Sergeant (European), Wickson (Japanese), Yellow Egg (European). The small, roundish fruit buds on the Wickson are characteristic of Japanese plums. The Robe de Sergeant has a more compact spur system than most European plums.



Pear

A terminal fruit bud is seen at A on this three-year-old portion of a pear spur. Two lateral leaf buds are marked B. Fruit was produced at C during the season preceding that when buds A and B were formed. Growth of B buds will give rise to characteristic branching of older pear spurs.

the weeds that compete with trees for water and nitrogen) must also be considered.

Trees just planted have relatively little carbohydrate but enough to start them into growth. As they develop, leaves are formed, which manufacture a new supply of carbohydrates. As the leaf area becomes greater, this supply is increased, the roots are extended farther into the soil, and the tree becomes vigorously vegetative; that is, it belongs to class 2.

If, however, such young trees are severely pruned early in the summer, so that growth made from food stored the previous season is removed and, in addition, the leaf area is seriously reduced, the tree will fail to grow as much as one less severely pruned or not pruned at all, other conditions being the same. This tends to represent a class 1 condition.

Keep a balance between growth and fruitfulness

If the young vigorous trees are less severely cut back, the consequent larger leaf area will permit a greater manufacture of carbohydrates. Then, provided the nitrogen supply is not markedly increased, there will be a tendency toward a decrease of vegetative activities, with increase in carbohydrate accumulation, and the trees will gradually become fruitful. Such plants fall into class 3.

Since every commercial orchardist aims to maintain his trees in this class, he should select his methods of cultivation, irrigation, pruning, and the like with the idea of securing a proper balance between vegetative growth and fruitfulness. The production of a larger number of fruits is not profitable unless it can be continued, and for this purpose a constant supply of new growth must be maintained as well. By knowing some of the materials needed to maintain this condition and some of the means for their regulation, the fruit grower has a direct and fairly accurate method of securing the type of tree he desires.

The conditions of class 4 are occasionally observed in old almond, prune, and pear orchards in California, which make little or no new growth. Although many fruit spurs are present, almost no fruit is produced. In these cases, the difficulty is frequently a lack of nitrogen, since large quantities of carbohydrates have usually been stored in the top. Such trees, when nitrogen and moisture are supplied, or when nitrogen is already available in the soil and moisture alone is supplied, usually produce for a few years but may fall back into class 4 unless improved soil management is accompanied by adequate pruning.

Likewise, a pruning that removes much of the old wood and permits a relatively



Two lateral fruit buds of the peach with a small leaf bud between.

greater nitrogen supply to the remaining branches and buds greatly increases the vegetativeness of these portions and often fruit production as well. To try to regulate such trees by pruning alone, however, would be futile, because balancing the top with the available nitrogen or moisture would mean reducing the top to a size that could hardly produce a commercial crop. Both the soil requirements and a more rational pruning method should be considered.

Relation of pruning to other cultural practices

Although pruning alone will not regulate the growth and productivity of the orchard, it is one of the most important factors in determining the balance between carbohydrate and nitrogen supply. It is, therefore, important to understand the principles involved before adopting a pruning system for any particular set of conditions.

There may be an adequate supply of

available nitrogen, but if soil moisture is so greatly reduced that the tree cannot utilize this food material, the pruning must maintain a proper balance. Pruning under such circumstances should probably be somewhat heavier in order to reduce the amount of water lost through leaf transpiration. It should also keep the proportion of nitrogen to carbohydrates the same as if sufficient soil moisture and nitrogen were available.

In the same way, fertilizers, irrigation, and cultivation affect the pruning practice by limiting or increasing the amounts of soil moisture and available minerals, especially nitrogenous compounds.

Occasionally, situations are encountered where poor drainage or a rising water table results in a restricted root development. Under such conditions pruning must be somewhat more severe so that the plant will not lose by transpiration more water than it can replace from the soil.

PRUNING RESPONSES . . .

the timing and severity of pruning are important in the development and productivity of fruit trees.

Pruning practice cannot be timed by the old axioms, "Prune when the knife is sharp" and "Summer prune for fruit and winter prune for wood."

Dormant pruning usually gives best results

For all deciduous orchards in California, except in a few special cases (page 11), pruning gives best results when done during the dormant season—that is, after leaf fall and before new growth starts the following spring, usually between the latter part of November and the first of March.

At the end of any growing season, the root and top development of a tree will

tend to reach a balance; that is, the root system is extensive enough to supply the top with adequate moisture and mineral salts from the soil, and the aboveground parts are sufficient to manufacture the complicated foods necessary for the future development of the whole plant.

When a young tree is dug from the nursery, with a consequent loss of roots, this balance is disturbed. If the top is not cut back when the tree is planted, too many buds will be left to grow, and the reduced root area will be unable to supply them with materials from the soil. This unbalanced condition may cause the tree to die or to make a feeble start.

If, however, the top is cut back at the

time of planting, each remaining bud will have a larger proportionate share of the available moisture and the mineral plant-food materials, and the subsequent growth will be more vigorous.

Remember that any pruning reduces, in proportion to its severity, not only stored food materials but also the potential leaf area, the principal "machinery" for manufacturing carbohydrates.

Heavy dormant pruning undoubtedly restricts maximum root development. The roots, being incapable of carbohydrate synthesis, depend upon the leaves and the aboveground parts for their supply. If such supply is limited by top pruning, the root system will be limited. A large top presupposes a large root system, and any limitation of root development tends to restrict the growth of stems and branches. In growth, development, and fruiting, the water and mineral intake are just as important as the substances built up or found in the tops themselves.

These observations on the retarding effects of pruning apply especially to the young nonbearing tree, where the dwarfing effects of blossoming and fruit production need not be considered. The removal of blossoms in itself will produce an invigorating vegetative effect, but luxuriant shoot growth is not accompanied by a heavy production of fruit.

It is easy to see, therefore, why the pruning of bearing trees may result in increased vigor, whereas the same severity of cutting may actually dwarf a young nonbearing tree. In the former case the invigorating effect of removing part of a potential fruit crop more than compensates for the dwarfing effect of losing some of the potential leaf area.

Spring pruning is to train young, nonbearing trees

The abundant literature on pruning contains many references to "summer pruning." Since growth begins three to six weeks earlier in California than in the

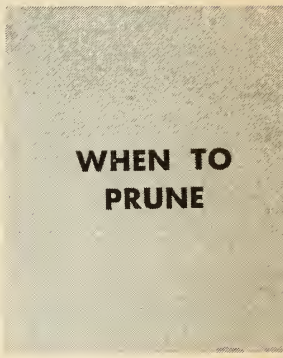
eastern United States, "summer pruning," as it is referred to there, could more rightly be called spring pruning here.

In nearly all instances, this practice has been intended to increase the fruitfulness of full-bearing trees, but this is of little importance in California. Spring cutting is important, however, in training the young nonbearing tree.

If the tree makes an excellent start, pruning may begin the first spring after planting. As soon as the young tender shoots are 3 to 4 inches long, examine each tree carefully and pinch back any growths not to be used in building its main framework. All the strength of the plant will then go toward a heavy, vigorous growth in the remaining branches, which are to be permanent. Very often, when undesirably placed shoots are suppressed by pinching off the tips, growth is induced where it is wanted.

In suppressing the undesirably placed growths, spare two or three leaves next to the trunk to shade it and thus prevent sunburn. It is wise to go over the orchard about a month or six weeks after this first thinning to see that no new, vigorous, undesirable shoots have arisen. If growth is very vigorous, the orchard should be gone over a third time and the terminal 6 to 8 inches of any vigorous undesirable shoots removed.

The question is sometimes raised as to the advisability of heading back the three main branches the first growing season. Best results have been secured by allowing them to grow undisturbed unless length growth is very rapid and the total growth is 5 feet or more. In these cases, the weight of the leaves may bend or break the branches, and the branches should be headed at the height desired for secondary branching.



WHEN TO PRUNE

Prune early in the season to direct growth

During the second and succeeding years, and until exuberant wood growth is slowed down by fruiting, the vigorously growing trees often need a pruning early in the season to direct all their energies into the branches that will be retained as the future framework. If the trees are favorably located and make a vigorous start the second summer, the new shoots usually attain by the middle of May a length equaling or exceeding that which should be left at the second dormant pruning.

With the long growing seasons experienced in nearly all the deciduous fruit sections of California, the dormant pruning usually performed the second winter can be moved up to the preceding May. In this way the ordinary second and third seasons' shaping is obtained during the second season. Pruning at this time not only hastens the training of the tree but removes many unnecessary shoots and thus reduces to the minimum the second dormant pruning.

Use several spring prunings to secure spread of branches

Judgment should be exercised in adopting this system of spring pruning. Trees must be grown under favorable soil and moisture conditions. If pruned early in the season and if other conditions are favorable, an orchard so treated should come into profitable bearing sooner.

Whether this spring training should be continued during the third and fourth seasons depends upon the exuberance of growth and upon the formation of fruit wood. If the trees show no indication of settling down to fruiting and vegetative growth is so dense that fruit spurs on the lower parts of the tree are shaded, spring pruning, especially a thinning process, may be advisable in later years.

Likewise, if sufficient branching has not been obtained, this spring pruning

may be employed for several seasons, being of special value in securing spread with obstinate upright-growing trees like the sweet cherry.

Summer pruning is usually labor wasted

Pruning at any time during the growing season is devitalizing, and summer cutting is more weakening than cutting done early in the season. Early spring growth is made at the expense of stored food material. Removing part of the foliage before these new leaves have had an opportunity to manufacture and store plant food robs the plant.

After active shoot elongation ceases, the plant turns its energies to manufacturing and storing plant food for the succeeding year. The later in the growing period a pruning is given, the greater will be the loss to the plant, in proportion to the severity of the pruning.

If summer cutting is designed to give the same relative shape as spring pruning, more wood must be removed by both thinning and heading, especially if the new branches are to be secured at about the same height from the ground.

Under the arid conditions in many orchard sections of California, the soil moisture may not be enough to force a vigorous new wood growth late in the season, even if such growth could be properly matured before the frosts of early winter. Likewise, late in the growing season many species of deciduous fruit trees will have entered the "rest" and will not respond with new growth, no matter how favorable moisture and temperature conditions are.*

If summer pruning is practiced on young trees, the orchardist will lose in two ways: 1) the leaf area of the trees will be reduced right at the beginning of maximum storage of plant food in fruit-

* For a discussion of this phenomenon, see "Deciduous orchards in California winters," by W. H. Chandler and Dillon S. Brown, Calif. Agr. Ext. Cir. 179, 1951.



Five-year-old Nonpareil almond trees after pruning. The tree on the left has been lightly pruned each year; the one on the right has been given a severe annual pruning. Each is a representative specimen of a number of trees similarly treated, and, except for the pruning, they have received identical treatment. Both trees were photographed from the same distance. Note the relative sizes of trees and branches.

ing vegetative parts; and 2) since summer pruning affords no benefits, the cost of pruning is lost.

Results from practical applications of spring pruning, on the other hand, seem to justify the practice, provided the trees are growing thriftily and provided the work is done as early as possible in the growing season.

Prune lightly until the tree comes into full bearing

The lighter the pruning of young trees, consistent with securing a proper framework of scaffold branches, the greater will be their development, and the sooner will profitable crops be produced. The more severely young trees are pruned, the longer they remain unfruitful. Con-

Trunks and main roots of five-year-old Nonpareil almond trees from the plantings shown above; tree on left was lightly pruned each year; tree on right heavily pruned. Note the greater trunk and root development of tree at left.





Mature Royal apricot tree pruned by the so-called "short" system, which is essentially a severe thinning-out and heading-back of new wood growth. Note the lack of fruit spurs in lower parts of the tree because of shading out. There are too many main scaffold branches.

Fifteen-year-old Bartlett pear tree typically "short" pruned. Note the severe thinning and heading-back. Only three or four buds have been left on each one-year shoot.



tinued heavy cutting not only lessens the chances for a fruit crop, especially with spur producers, but materially reduces wood development.

According to common experience with fruit trees just beginning good production, injudicious heavy cutting during one season may so disturb the delicate balance between wood growth and fruiting as to delay profitable crops for three or four years.

One must exercise the best judgment in selecting the pruning treatment for a particular orchard, especially when trees are just approaching the bearing age.

As trees become older and bearing is fully established, heavier pruning may often be necessary in order to continue regular bearing while maintaining the necessary wood growth. For this, supplementary fertilization may be advisable or even necessary.

Pruning the bearing tree

Much discussion has centered around the relative merits of so-called "long" and "short" pruning. It is hard to draw a definite line between the two because, with their modifications, they merge into each other.

Briefly, "short" pruning is essentially a rather severe thinning-out, accompanied by a heavy heading of the new growth; "long" pruning means a moderate thinning-out while keeping the tree within bounds by cutting to laterals that are left untouched. Although "long" pruning removes somewhat less, the conclusion that it really amounts to little or no pruning is incorrect.

Throughout the state, during the past thirty years, there has been such a tendency toward less severe pruning that now it is not easy to distinguish between orchards "short" and "long" pruned. Thoughtful and observant orchardists realize that the same principles of plant growth and response apply with equal force no matter how severe the pruning.

As their idea of the relation between vegetative growth, tonnage, quality, and economy of orchard management becomes clearer, they recognize that the different systems now in use merge into each other and that the right amount of pruning for any particular case will lie at some point between the extremes of "short" and "long" pruning.

Several modifications of "short" and "long" pruning are in use in certain sections of California. Undoubtedly many growers who are following one of these methods may differ as to the classification here made.

How to treat pruning wounds

If a tree is properly pruned from the start, the removal of large limbs can usually be avoided.

In removing large branches, make all cuts close to the limb from which the branch arises. This will promote rapid healing.

Treatment of pruning wounds depends largely upon local conditions. In a section like the Watsonville apple district,

where the foggy climate favors germination and growth of the fungi that cause wood decay, pruning cuts should be disinfected as soon as the wood has dried a little but before any cracks have formed. Where the air is relatively dry, pruning wounds seldom need disinfection.

It is desirable to cover large wounds with some protective substance—not to aid the healing but to prevent the entrance of rot-causing fungi.

Bordeaux paste is a good disinfectant and wound covering, but it must be replaced every year or two until the wound has completely healed. A more nearly permanent covering is possible by combining bordeaux powder with a viscous mixture of white lead and raw linseed oil. Enough bordeaux powder (one package) is added to make the mixture a light blue color.

Other materials that are not disinfectants are often used for wound coverings. White lead paint mixed with raw linseed oil has been widely used. Many proprietary materials are on the market, most of which are asphaltum compounds or emulsions to be applied cold.



A well-made pruning cut. Note the callus formation, which in the course of a few years will completely cover the large wound. Compare the size of the cut with the quarter dollar.



Improperly made pruning cuts. Such stubs will never heal over and are a constant menace in affording an entrance to wood-rotting organisms.

TRAINING SYSTEMS . . .

the shape of the tree and arrangement of its framework branches are determined by training systems applied to the young tree. There are three basic systems.

The leader type of tree, once fairly common in America, is occasionally found in some California walnut orchards and old orchard sections of the East, as well as in Europe. The topmost branch is encouraged to predominate. As time passes, the tree becomes pyramid shaped, although it is difficult to maintain the lower branches because of shading by the upper ones. This type of tree has little to recommend it to the commercial orchardists of California.

The modified leader type of tree assures a mechanically strong framework. Trees of this type are occasionally seen in California, although not to the extent the system merits. At the first dormant pruning, the topmost limb is left considerably longer than the others. The tree is trained to the typical leader form for several years, after which the leader is cut to a lateral branch. The result is the development of four to six well-spaced scaffold branches with strong crotches. Walnuts, pecans, and some varieties of apples adapt themselves particularly well to this style.

The open center type is most common in California, accounting for probably 75 per cent or more of the deciduous fruit trees. Properly applied, the system has proved entirely satisfactory.

Under this system, the uppermost branch is left several inches longer than the others. If this is not done, the upper branch will often be choked out by the more rapid development of the lower branches. The centers are kept as open as possible without exposing the branches to sunburn. The degree of center openness varies with the species, with local conditions, and with the grower's personal ideal.

One defect of this system has been that

all the scaffold limbs may arise from one point on the trunk. Unless wide angles are formed by the scaffolds, the crotches will be relatively weak. Basin crotches or water pockets may also develop, especially in the upright-growing varieties such as the French prune. Consequently, heart-rot occurs, with breakage from a heavy load of fruit when the trees should be producing maximum crops.

Variations of the training systems

Over the years systems of training that are distinct departures from the usual methods have been devised by growers of various fruits in certain areas. Most of these have now been generally discarded for one reason or another. Some are, however, of enough interest historically to be described briefly.

The Winters system of training apricot trees produces a flattened expanse of the fruiting area, designed to give better exposure to the sun so that fruit will ripen earlier. It does not, however, bring about this result because the heavy cutting gives rise to succulent vegetative growth early in the season. This vigorous growth utilizes carbohydrates which normally would go to the developing fruit and also delays color development because of the shade.

This method of training is also objectionable because the upper sides of the main branches are often badly sunburned, even though vegetative growth develops early in the spring. Frequently the result is wood decay.

Moreover, restricting the height of the tree so that all work is done from an 8-foot ladder materially reduces the fruiting area and the possible tonnage of high quality fruit.

The Sims system of training peach trees is characterized by relatively few upright scaffold branches clothed with long, slender fruiting twigs. These scaffolds can hold a heavy load of fruit with the minimum of bracing. The rather narrow spread of trees thus pruned is perhaps an unwarranted restriction of the fruiting area. Trees pruned by this system do not yield maximum crops.

The Dahlgren system, now being tried by a number of growers, is the other extreme in the training of peach trees. Many scaffold branches are developed relatively low in the tree. Horizontal spreading branches are encouraged. There may be 40 to 50 branch terminals on the periphery (outside) of a tree, compared with only 7 to 10 on a Sims-trained tree. The purpose of the system is to give a low spreading tree with early heavy bearing. The system has not been in use long enough to test it adequately. The low spreading branches may make certain cultural operations more difficult.

The Caldwell system is an interesting departure from the standard training practice for pears. This consists of tying down the upright one-year shoots at an angle somewhat below the horizontal. The resultant new growth arises just below and behind the highest point of the bend. Almost all growth beyond this point is reproductive in character and rapidly develops a good fruit-spur system.

In principle the Caldwell plan closely resembles the espalier method of training used in Europe. In both cases, the bending of the branches seems to induce fruitfulness. At each dormant season, all the new shoots are so tied down that there is little shading of the lower branches. The later tying is done to any convenient point on either trunk or branch.

Briefly, the advantages claimed are that large trees of good mechanical strength, and with a large fruiting area close to the ground, are secured in a comparatively short period; that they come

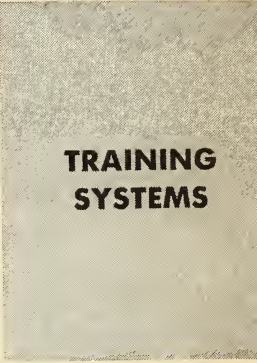
into bearing two to four years earlier than trees trained by severe cutting back; that they can be trained to a more shapely form in a windy section or where prevailing winds hinder symmetrical development; and, finally that they produce larger crops of satisfactory quality.

The chief disadvantage is that this system, to be successful, must be part of a comprehensive and intensive orchard program. Since more wood is conserved than with other methods, the grower must provide adequate moisture and fertility in order to secure an abundance of new wood while carrying large crops through to maturity and while supplying the enormous leaf area, which is being increased from year to year.

In most soils, as soon as the trees begin bearing heavily, some renewal pruning is necessary in order to replace the fruit wood that has outlived its usefulness and to maintain a proper condition of vegetative vigor. Success largely depends upon skill and judgment. The method is probably applicable only to nonbearing pears and should not be adopted without a full understanding of its requirements and limitations.

Choose the right system

The most important question is: Will the system chosen insure a good tonnage of high quality fruit each year? The growth of new wood is probably the only way to judge whether or not future yields are being sacrificed for the sake of one or two heavy crops. On the other hand, the production of too much vegetative growth will reduce the yields far below the maximum that can be profitably maintained.



TRAINING SYSTEMS



Left, the leader type of walnut tree, showing a strong framework of branches. Right, nine-year-old walnut tree trained to the modified leader. Note the high, upright trunk with good vertical spacing of the main scaffold branches. The leader was trained to a main scaffold after the lower branches were established.

T R A I N I N G S Y S T E M S . . .

Twelve-year-old apricot tree after pruning. Note the strong scaffold framework with good vertical distribution resulting from the open center training system.





Left, a peach tree showing a possible hazard of the open center type of training. Note the choking-out of the central or topmost branch by the more vigorous growth of the lower branches. Right, this ten-year-old almond tree, trained for an open center, shows the result of selecting branches arising from one point on the main trunk.

SOME DO'S AND SOME DON'TS

Winters system of apricot training. Note the low-spreading top and the severity with which new shoot growth has been headed.





AND SOME EXAMPLES

Mature peach tree trained by the Sims system. Note the heavy framework branches. Fruit is produced on "hangers." By this unusual method much fruit is produced on spurs. After reaching a certain height (12 to 16 feet) trees are never allowed to grow taller.

Dahlgren system of training peach trees, showing the abundance of fruit wood left and the many low scaffold branches. The point at which the lowest branch on the right arises is 3 feet from the ground.



Caldwell system of pear training. Six-year-old Bartlett pear tree trained by tying down new shoots each year. Note new branches arising at the bend. These will in turn be tied down to a position a little below the horizontal.



THE YOUNG NONBEARING TREE . . .

proper pruning will help bring fruit trees into profitable bearing at an early age. General recommendations are outlined here as well as specific practices for various types of trees.

Every California fruit grower is economically interested in handling his orchard so that it will come into profitable bearing at an early age. Proper pruning should bring some deciduous fruit trees into bearing by the fourth season in the orchard. Early fruiting is also consistent with the tree's best development.

Have in mind the ideal tree as it will be at maturity

In training the young tree before it reaches bearing age, keep in mind the following principles.

Height of main trunk is determined when the tree is planted.

Fruit trees grow higher only through bud growth and elongation of the terminal growing point. The height of the main trunk is determined when the tree is cut back at planting. In this discussion the term *height of head* will refer to the distance between the ground and the lowest scaffold limb. The lower the head, the greater the shading of the trunk and the less the sunburn or sunscald. This point should be especially emphasized for orchards in the hot interior valleys.

Cut to primary scaffolds that will make a strong tree. Enough trunk space should be left so that there will be at least 6 inches, preferably 8 to 12, between the primary scaffold limbs. Thus, if the young tree is arbitrarily cut off at 24 inches from the ground and three primary scaffolds are selected, the lowest one should stand 8 to 12 inches from the ground.

Personal preference will determine the number of primary scaffolds, but take care not to have too many. Two or three at the first dormant pruning will be

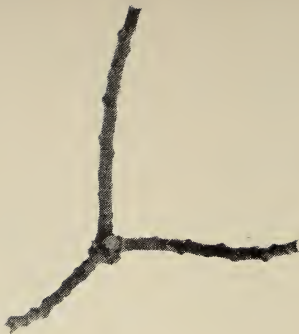
enough. Four or five primary scaffolds will necessitate cutting the tree rather high at planting time or else spending several years in developing them. At 5 feet from the ground, five to seven primary and secondary scaffolds are all that can usually be accommodated without crowding. At all times, think of the ideal tree as it will appear at maturity, and prune accordingly.

If three primary scaffolds are selected, they should be properly balanced around the trunk, forming equal angles of about 120 degrees each. Even more important, they should be spaced up and down the trunk as directed above.

Head back according to length and angle of new growth. The primary scaffolds should be headed at 15 to 30 inches or more from their juncture with the trunk. The severity of this first heading depends upon the total length of new wood, its angle of growth, and the formation of lateral branches on current season's wood (as in the case of the peach). Although general statements may be somewhat misleading, some idea can be given of how much heading-back the young tree should receive at the first dormant pruning.

The greater the amount of one-year growth, the longer the branch may be left. The secondary branching must not, however, come too high. The more horizontal the growth, the more severe will be the necessary heading-back in order to secure the

**THE YOUNG
NONBEARING
TREE**



Looking downward on a young tree showing a satisfactory arrangement of primary scaffold branches around the trunk. This will give balance and symmetry to the tree.

uprightness necessary for mechanical strength and ease of cultivation.

Trees forming branches on current season's growth may be headed more lightly or not at all. Such heading as is given, since it comes above the forks formed naturally during the growing season, is designed not to secure additional branching, but rather to secure proper angle and spread.

Light pruning encourages total growth in young trees. The primary scaffolds, headed lightly at the end of the first growing season, will allow enough room for the secondary scaffold branches to develop the second summer. With such fruits as the almond, apricot, peach, and Japanese plum no further heading is desirable (if sufficient branching and spread have been obtained with the one

Keep these points in mind . . .

- Young trees should have their tops cut back at planting:
 - a) To balance the loss of roots removed in digging from the nursery.
 - b) To form a low head for future profitable orchard management.
- Sunburn may be controlled, in part, through shading by means of low-headed trees.
- Only three main, or primary, scaffold limbs are desirable, and these should be spaced 6 to 8 inches apart at the points where they arise from the trunk. Branches should be evenly distributed around the trunk (page 21).
- Nursery lateral branches, if properly distributed and of good size and maturity, may be used in forming the head of the tree at planting time.
- For a mature tree, five to seven primary and secondary scaffolds at 5 feet from the ground are enough.
 - After securing the desired number of scaffold branches, together with the proper spread, it is useless (except with certain species and varieties) to head back the young tree again.
- Lightly pruned trees have stockier and stronger branches than heavily pruned trees.
- The more lightly a tree is pruned, the greater the development of both top and root (page 13).
- Cutting any branch or part of a tree heavily lessens total growth in that branch or part. Pruning any part lightly increases the total growth in that part (page 23).
- Lightly pruned trees come into bearing one to three years earlier than similar trees that have been heavily pruned.
- Early bearing does not interfere with future productivity.
- Summer pruning tends to be weakening and to result in somewhat smaller trees. Under certain conditions, however, spring pruning may be advisable.

light heading) until the tree comes into full bearing, when the active vegetative growth is naturally retarded. Under certain conditions, cherries, pears, and other fruit trees with similar growth habits need additional headings (winter or summer) to secure the necessary framework and desired spread.

Varietal characteristics and climate largely determine whether or not lateral branches will be formed by only a thinning-out system of pruning. The Bartlett pear, for example, under certain conditions throws laterals without being headed back, but under other conditions must be headed to force laterals.

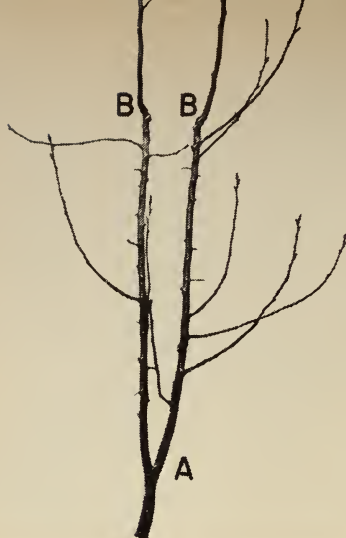
Judicious use of heavy and light pruning are as important in maintaining

proper balance between the various parts of the young tree as they are in regulating total growth. To encourage any branch or portion of a tree, it must be pruned rather lightly in comparison with the parts with which it must compete.

Even cutting results in a mechanically weak crotch. If two shoots forking from the same branch are headed evenly, they tend to develop equally with a crotch that is usually mechanically weak. But if the shoot that best continues the general direction of the framework is cut longer, it will grow strong. The second and shorter shoot will then develop into a minor branch, forming a strong crotch. *Never* allow three branches to arise from one point.



On the left, an apricot tree after one season's growth in the orchard; right, the same tree after pruning. Spacing of primary scaffolds up and down the trunk must be sufficient to secure mechanical strength and to avoid weak, debris-catching crotches. Compare with the two-year-old apricot tree shown on page 25 and the one pictured on page 18.



Left, equal development of branches and resulting sharp-angled, weak crotch (at A) occasioned by even cutting at B. Right, unequal development of branches and mechanically strong crotch caused by uneven pruning at points A and B. These branches are of the same age.

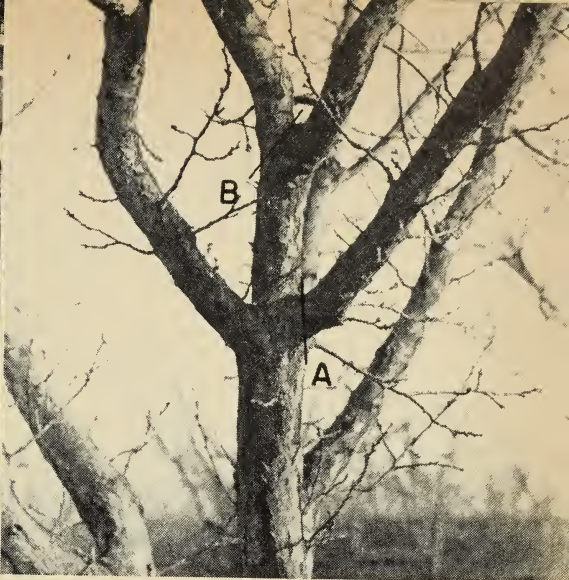
Train young fruit trees according to growth habits

The different deciduous fruits may be roughly grouped into two classes according to growth habits. The first class con-

tains those fruit trees that form side branches on current season's growth (see the peach tree illustration on page 27); this includes the almond, apricot, nectarine, peach, and Japanese plum.

Left, a branch of an apricot tree cut severely to a stub at the preceding dormant pruning; right, the same branch after pruning. Unnecessary wood growth should have been removed early in May; little pruning would then have been necessary through the winter. Better still, this branch should not have been cut back so heavily at the previous pruning. In the pruned branch, note the weak crotch and large pruning wounds.





Left, two-year-old apricot tree broken down because of weak crotch. Scaffolds emerged too close to each other on the trunk. Compare with the illustrations below of a two-year-old tree with well-selected scaffolds. Right, portion of the framework of a young bearing apricot tree. Note the crowded condition of the scaffold branches caused by allowing three branches to arise at one point, A. Difficulty would have been avoided if the cuts indicated at A and B had been made three or four years before.

Left, a two-year-old apricot tree before pruning. At the end of the first year, this tree was much the same as the one shown on page 23. Right, the same tree after pruning. Note the dominance of the central branch, which will gradually be subdued, and the five secondary scaffold branches. This type of training will eventually result in such a tree as that shown on page 18.



The trees of the second class—the apple, cherry, fig, pear, pecan, persimmon, European plum, quince, and walnut—do not usually form side branches on the current year's wood (see the illustration of prune branches on page 35). Different pruning may, however, be needed for trees in the same class.

In general, the trees of the first class can be brought into bearing somewhat sooner than those of the second. Furthermore, a symmetrical framework is more quickly and easily formed by the trees in the first class.

Trees forming side branches on current season's growth: almonds, apricots, nectarines, peaches, Japanese plums:

At planting cut the nursery tree at a height of 24 to 30 inches above the ground. The head of some of the trees occasionally may be shaped at planting time by utilizing side branches formed in the nursery. If selected, they should be cut to 4 to 6 inches long. In case these branches are unsuitable, cut them back to half-inch stubs. Take care not to injure the ring of tissue surrounding the twig at its juncture with the trunk. It is from this tissue that new shoots arise.

Give the young tree a coat of whitewash soon after planting to prevent sunburn on the trunk.

First spring. During April go over the tree carefully and select the primary scaffolds if this was not done at planting time. Pinch back all undesirable growths.

First dormant season. At the first dormant pruning, thin the trees to two or three primary scaffolds, properly spaced, and cut these scaffolds back lightly above the secondary branching. Take care to leave the topmost branch longer so it will not be choked out.

Second spring. During May of the second season thin out all unnecessary growth.

Second dormant pruning. The tree will need only a thinning-out at the second dormant pruning.

Third dormant pruning. Again, only a thinning-out is needed.

After the first growing season branches on the trees in this group should not be cut to stubs unless absolutely essential.

Trees in this group handled according to the above plan should produce a crop during the fourth season in the orchard and may thereafter be treated as bearing. Good soil conditions and careful cultural treatment are assumed.

Trees without side branches on current season's growth: apples, cherries, figs, pears, persimmons, European plums, prunes, and quinces:

At planting cut the nursery tree at a height of 24 to 30 inches above the ground. Give the young tree a coat of whitewash soon after planting to prevent sunburn on the trunk.

First spring. During April go over the tree carefully and select two or three primary scaffold branches. Pinch back all undesirable growths.

First dormant season. Thin the trees to the two or three properly spaced primary scaffold branches. With apples, cherries, figs (certain varieties), pears, persimmons, and plums, cut back these scaffolds to a length of 20 to 30 inches or more. The primary scaffold branches of Mission and Adriatic figs may be left unheaded at this time.

Second spring. During May of the second season thin out all unnecessary growth. If the trees are growing vigorously, a heading-back of the secondary scaffold branches, in addition to the thinning process, may be given to those varieties that were headed at the time of the dormant pruning. Under favorable conditions, the usual second and third year's shaping is accomplished during the second season.

Second dormant season. With the exception of the sweet cherry (all varieties) and certain varieties of the other fruits in this group, the pruning given during the second dormant season will consist of a thinning-out only.



One-year-old peach tree before and after pruning.

Because the sweet cherry tree produces most of its new growth from terminal buds, it has a decided tendency to develop long, pole-like branches if no heading is done. Growers usually cut back cherry trees moderately the first four or five years, or until the framework is completed.

After the first few years, any further heading will delay the fruiting; the de-

sired form can generally be attained by a thinning-out of superfluous growths. The cherry is slow in coming into bearing; as long as new wood growth is encouraged by rather heavy cutting, the tree will make only shoot growth and fail to develop fruit spurs.

In many varieties of apples, figs, pears, persimmons, European plums, and prunes, heading-back one-year branches

Two-year-old peach tree before and after pruning.



will tend to force all new shoot growth to arise from near the pruning cuts. If, on the other hand, these same branches are not cut back, the new shoots, except in certain varieties, will be well distributed up and down the previous year's growth.

Notable exceptions to this rule are the Spitzenburg apple (*Esopus Spitzenburg*) and the Pond plum, which resemble the sweet cherry in that new shoot growth arises from the tip of one-year wood whether or not this has been headed.

The Bartlett pear, in most locations in California, will branch satisfactorily without heading. Because, however, this variety grows vigorously in soils well adapted to pears, in most districts it is desirable to head all primary scaffolds at the point where new branches are wanted; otherwise, many of the long one-year shoots may bend and break. This heading of the scaffolds is usually continued until the framework of the tree is completed.

Third dormant season and following. The same pruning as that outlined for the end of the second growing season should be given during the third dormant season and until the trees come into bearing.

Figs, prunes, and European plums may be expected to become profitable somewhat sooner than apples and pears. In general, the latter bear sooner than cherries and walnuts. Varieties of the same fruit reach profitable bearing at different ages; the Wagener apple, for example, is noted for its early fruiting, whereas the Northern Spy is notoriously slow in reaching productivity.

The Calimyrna fig normally produces long branches without laterals on current season's wood. Heavy winter or light spring pruning may be used to shorten the branches and force out laterals closer to the trunk. In winter the shoots may be cut back to stubs about 20 inches long. As the tree begins to bear and as these shoots become less vigorous, less cutting-back will be required. The top should be

thinned out so that it does not become too dense. Pinching off the tips of these long branches in the spring causes laterals to push out. This method should, however, be practiced only on vigorous trees early in the season.

In pruning the Mission fig, the scaffold branches must be selected with special care because of the acute angle usually formed at the junction of the new branch with the parent shoot. Splitting at this point often occurs with a heavy load of fruit.

Trees in this group may be expected to produce a crop during the fourth to eighth season and should thereafter be handled as bearing trees. Good soil conditions and careful cultural treatment are assumed.

Walnuts

At planting, trees in all interior districts should be cut back heavily to produce low growth and prevent sunburn and borer injury. Five buds above the bud or graft union are enough. In coastal districts where sunburn is not a problem, trees can be headed at 3 or 4 feet. In such cases, take care to pinch back all lower shoots during the first season in order to force growth in the terminal parts.

First spring. If growing conditions are exceptionally good, select a single shoot during the first spring. Pinch back all others. The rapidly growing shoot should be tied securely to a stake (extending 8 feet above the ground) to prevent wind breakage.

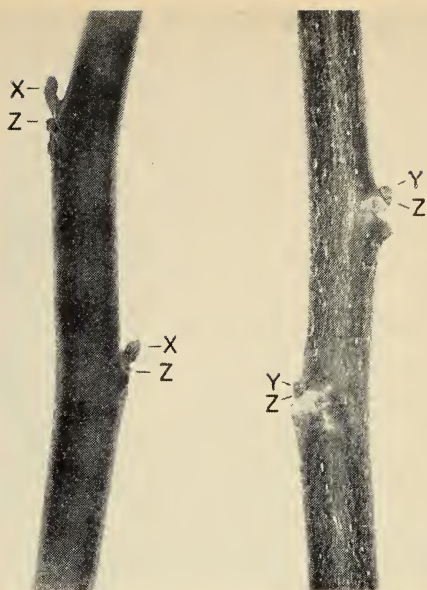
First dormant season. After the first year's growth in the orchard the selected leader should be headed back to stimulate growth of lateral shoots which otherwise may be few on vigorous trees of some varieties. If the leader is higher than the stake, leave at least three buds above the stake top. If the leader has not yet reached the stake top, cut off only two or three buds. In either case, cut to a bud on the side toward the prevailing summer winds. Cut off all laterals that develop the

same season as the parent branch. These laterals make an acute angle with the parent branch and split off easily. Also remove all "necked" buds because branches arising from them have similar acute angles and structurally weak crotches. All permanent branches should come from short primary one-year buds without a noticeable neck or from secondary buds which are below the primary buds in the same leaf axil.

Second dormant season and following. Select the first primary scaffold branch following the second or third year's growth. Preferably it should face the prevailing summer winds at a height of about $5\frac{1}{2}$ to 6 feet. Other scaffold branches should be selected in a spiral pattern around the trunk about $1\frac{1}{2}$ to 2 feet apart vertically. Branches developing below the desired level should be stubbed back to two or three buds. Shoots from these stubs will shade, nourish, and stiffen the lower trunk.

Maintain a vigorously growing leader upright by removing strongly competing branches; each year head back the leader to a bud into the wind until four to six primary scaffold branches have been established. Then the leader may be allowed to bend and become another primary scaffold branch, thus making the center of the tree more open above. Throughout their development and as long as they are making 3 feet or more of new growth per year, head back the primary scaffold branches and the leader in varieties with the Payne bearing habit (many lateral buds fruitful on young trees). Scaffold branches of other varieties need not be headed unless they are too flat, too upright, or so vigorous that they are outgrowing the leader. Remove all laterals arising on framework branches during the same season the parent shoot grew to avoid narrow, weak crotches.

Remove vigorous laterals arising on main scaffold branches less than 4 feet from the trunk. Thin out vigorous later-



"Necked" buds at x should be removed from walnut trees to prevent the formation of branches with weak narrow crotch angles. Branches from short primary buds, y, or secondary buds, z, will form strong wide crotch angles.

als arising from secondary scaffold branches, leaving them no closer than 2 to 3 feet apart. Continue stubbing back to two-bud spurs all excess branches on the trunk until the trunk is about 6 inches in diameter at the base and is strong and stiff enough to stand alone. Then cut off these stubs close to the trunk; the stake can be removed at this time.

Pecans

In general, the training suggestions for walnuts may be applied to pecan trees. Pecans should be trained to the modified leader. In some varieties there is a tendency to produce many mechanically weak, narrow-angled crotches with bark inclusions. These should be eliminated to prevent limb splitting when the tree matures. Varieties with brittle wood, like Mahan, growing vigorously in windy locations, should be headed back to reduce limb breakage.

TRAINING

Left, one-year graft on five-year-old rootstock (after pruning). Upright leader selected and headed at about 9 feet, with four buds left above the stake. All laterals and necked buds removed from leader to avoid narrow, weak crotches. Extra graft stubbed to two buds and left to help heal over the large wound. Sprouts on the rootstock completely removed in the winter but allowed to grow in the summer (headed several times) to protect the rootstock from sunburn. The tree is kept securely tied.

Left below, two-year-old graft (before pruning except water sprouts removed). Note the good development of lateral branches.

Below, two-year-old graft (after pruning). Upright shoot selected to continue leader and headed about one-third. Three primary scaffold branches selected. The lowest is about 6 feet from the ground, the others 1½ to 2 feet apart vertically and 120° around the trunk. The scaffold branches are headed one-third (Payne-type variety). Excess laterals strongly competing with the leader are removed completely. The others are cut back to two-bud spurs to nourish, stiffen, and protect the trunk

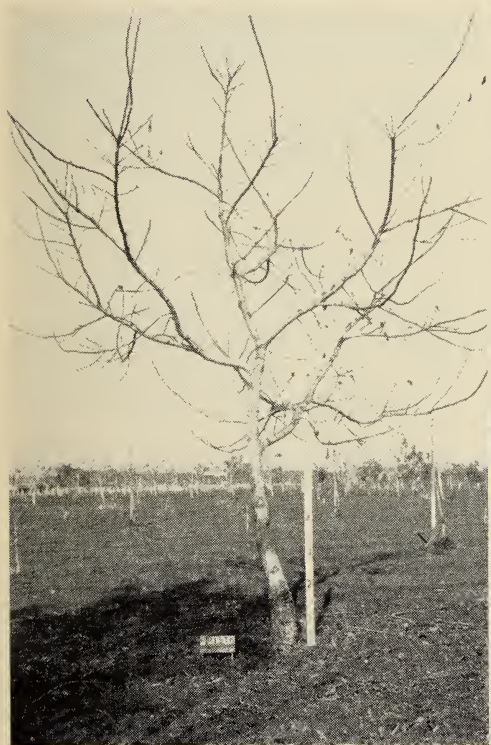


WALNUTS

Right, three-year-old graft (before pruning). Note the good development of the laterals on the upper part of the leader. Good growth from the stubs on the lower part of the leader has caused it to develop into a sturdy, tapering trunk about 5 inches in diameter at the base and just stiff enough to stand alone against the winds so that the stake has been removed.

Right below, three-year-old graft (after pruning). Two new primary scaffold branches at the top complete the framework so that further maintenance of the leader is not needed. Scaffold branches are not headed back (Franquette type, few lateral buds fruitful). Extra low branches are stubbed and will be kept one more year to further strengthen the trunk.

Below, five-year-old bud on seven-year-old rootstock (after pruning). Seven primary framework branches reasonably well spaced vertically on the trunk. The third branch from the bottom should have been a little higher. The current tip growth on the main limbs over 3 feet long is headed back one-third (Payne-type variety).



THE BEARING TREE . . .

each year a certain amount of pruning is needed to insure a constant renewal of fruit wood. Here are the general principles involved and suggestions for handling specific trees.

Most orchardists find that a certain amount of pruning to insure a constant renewal of fruit wood is necessary each year, even though with some species the amount of wood removed may be comparatively small.

To prune fruit trees intelligently one must thoroughly understand the fruiting habits of the various species and be able to distinguish between fruit and leaf buds.

The following general points form the

foundation on which specific pruning practices are based.

Distinguish between fruit and leaf buds. The fruit buds of the apple, pear, peach, apricot, and plum are larger and plumper than the leaf buds and less sharply pointed. Cherry fruit buds are difficult to distinguish until they begin to swell. The surest way of determining fruit buds is to section them lengthwise with a sharp knife or razor. The fruit buds of the apple, pear, cherry, and plum

Table 1.—Portion of the Crop Borne on Buds in the Various Positions.

Fruit	Lateral on long shoots	Terminal on long shoots	Lateral on spurs	Terminal on spurs
Almond	Minor	.....	Major	.....
Apple	Minor	Very minor	.....	Major
Apricot	Minor	.....	Major	.....
Cherry, sour	Major or minor	.....	Minor or major	.....
Cherry, sweet	Minor	.....	Major	.....
Fig	Major	.....	.....	.....
Nectarine	Major	.....	Minor	.....
Peach	Major	.....	Minor	.....
Pear	Minor	Very minor	.....	Major
Pecan	Minor on young trees	Major on young trees	Minor on mature trees	Major on mature trees
Persimmon	Major	Minor	.....	.....
Plum, European	Very minor	.....	Major	.....
Plum, Japanese	Minor	.....	Major	.....
Quince	Major	Minor	.....	.....
Walnut				
Payne, etc. (many lateral buds fruitful)	Major on young trees	Minor on young trees	Minor or equal on mature trees	Equal or major on mature trees
Franquette, Placentia, etc. (few lateral buds fruitful)	Minor on young trees	Major on young trees	Minor on mature trees	Major on mature trees

Keep these points in mind . . .

- Judge whether the pruning has been of the proper severity by estimating the total amount of new growth the tree makes, considering the crop produced and the conditions under which it is grown (page 34).
 - a) If new growth is longer than seems desirable, the previous pruning was too severe.
 - b) If new growth has been inadequate, the cutting was too light.
- Pruning should include thinning-out of fruiting shoots. This thinning should be followed, where necessary, by a thorough hand-thinning of the fruit (page 34).
- The tree must be thinned enough to admit an adequate amount of light (page 34).
- All interfering branches, dead wood, and diseased parts should be removed.
- The larger limbs must be spaced far enough apart throughout their length to have ample room for developing the desired fruiting branches and spurs.
- The trees may be kept from becoming too high by regularly cutting back the tallest branches to strong, outward-growing laterals.
- All branches must be cut off close to the limb from which they arise, leaving no stubs (page 15).
- Trees must be planted far enough apart to develop normally; otherwise ideal shape, height, and distribution of fruit wood cannot be secured.
- Other phases of orchard management cannot be neglected—fertilization, cultivation, spraying, fruit thinning, and irrigation. Careful pruning is important, but no more so than these other cultural operations.

contain several roundish bodies, each of which develops into a flower. Each fruit bud of the almond, peach, and apricot contains the rudiments of a single flower. A pocket magnifying glass is helpful in this examination.

A knowledge of the usual position of fruit buds is helpful, especially during the dormant season, in determining the prospects for a crop the next season. Table 1 and the following key give this information for the more important deciduous fruits.

Fruit buds are usually borne:

1. On comparatively long shoots of the past-season one-year wood:

a) Lateral (page 9): In this position are found almost all the fruit buds of the peach, quince, and olive; part of those of apricots, almonds, plums, and cherries, and sometimes of pears, apples, and walnuts; and the fruit buds for the first crop of figs. Apricots, peaches, and Japanese plums often bear three buds at a node. In this case, the center one is usually a

leaf bud, and the two outer ones are fruit buds.

b) Terminal: Some varieties of apples and pears frequently bear a considerable number of fruit buds in this way.

2. On comparatively short shoots (spurs) of the past season. (These short shoots constitute either an extension of the spur system already established or the beginning of a new spur.)

a) On short- or medium-lived spurs, which may live one to eight years (see the illustrations on page 8). Most of the fruit buds of apricots, plums, and almonds are borne laterally and walnuts terminally in this position. Peaches occasionally bear a small part of their fruit buds in this manner. Peach fruit spurs are the shortest-lived, walnut the longest; between them fall apricot, almond, and plum, in that order.

**THE
BEARING
TREE**

b) On long-lived spurs that live ten to twenty years but should be renewed (or at least invigorated) oftener. Most fruit buds of sweet cherries and part of those of sour cherries are borne laterally, and most of the fruit buds of the apple and pear are borne terminally on spurs (see page 8).

Fruitfulness is associated with new wood growth. The amount and character of the new wood produced during any season are clues to the conditions existing within the tree. The amount of new vegetation necessary to maintain the correct balance apparently differs among species.

In general, in fruits like the peach, which bear most of their crop on one-year wood, fruitfulness is associated with a relatively greater amount of new growth than seems necessary with spur-producers. In spur-producers, the species with the longest-lived spurs apparently need the least new wood. This seems reasonable, since at least part of such new growth must be used to replace fruit wood that has outlived its usefulness.

The amount of new growth necessary for continued fruitfulness may vary from a few inches, in such fruits as the apple and pear, to 2 to 4 feet in the peach (table 2).

Pruning should distribute the fruit wood uniformly throughout the tree and thus secure greater tonnage of better quality. The trees are thus kept within bounds, and the costs of maintenance and harvesting are reduced.

Sufficient light in all fruit-producing parts of the tree is essential for uniform distribution of fruit buds. Pruning is practically the only way to secure favorable light distribution (see page 35). In general, thinning-out encourages fruit-spur formation more than heading-back.

Although fruit buds for any crop begin their visible development the previous summer (June to August, under practically all California conditions), pruning bearing trees during these months to secure greater fruitfulness is of doubtful value.

Pruning should be part of each year's operations, even though the amount of wood removed may in some instances be comparatively small.

Only consistent and regular pruning over a period of years will produce optimum results. With some species, the trees may be left unpruned for several years; but the net returns over a number of years will be smaller than those secured from annual cutting, which insures a constant renewal of fruit wood.

Proper pruning helps regulate size and quality of fruit. Since fruit trees normally tend to produce more fruit than can be matured successfully, this burden is generally reduced somewhat at the annual dormant pruning. Because of certain fruiting habits, danger from spring frosts, liability to the June drop, and other factors that may decrease the final crop, not all fruit thinning can be done with the pruning shears. Some hand-thinning will be necessary.

Table 2.—Desirable Amounts of New Growth for Bearing Trees.

Fruits	Under 10 years of age	Over 10 years of age
	inches	inches
Peaches.....	20 to 40	12 to 30
Apricots.....	12 to 30	10 to 24
Plums (except prunes) and quinces.....	10 to 24	9 to 18
Almonds, prunes, apples, pears, cherries.....	9 to 18	6 to 10

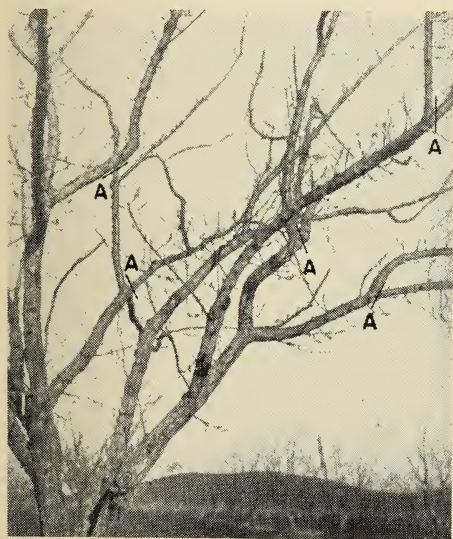
Trying to achieve desired fruit size and quality by pruning alone will reduce the crop to less than the trees could successfully mature. Such severe pruning is, moreover, harmful to future productivity.

There is apparently a direct correlation between new vegetative growth and fruit size. Trees that make a satisfactory wood growth usually produce larger fruit.

Color, size, finish, and flavor constitute quality in fruits. With certain fruits, light is of prime importance in securing color. If the tree is correctly "opened up" by pruning, little difficulty will be experienced in this connection.

In allowing light to penetrate to the tree's interior, do not expose the scaffold branches to the sun's direct rays. The result would be sunburn, with subsequent decay of the wood. Likewise, there must be enough new growth to shade the fruit and protect it from sunburn, especially in the dry, hot interior valleys.

Certain fruits, such as the apricot, attain early maturity and best shipping quality when the trees are maintained at a relatively low nitrogen level (intermediate between classes 3 and 4, page



Pruning by thinning-out. The A's indicate typical cuts.



Left, a two-year-old prune branch not headed back at the end of the previous season; note the production of fruit spurs, together with sufficient new wood. Right, a two-year-old prune branch, which received a heading-back at the end of the previous season, note the production of shoots and the lack of fruit spurs.

5). Trees in this state of nutrition will not produce maximum crops. A relatively high nitrogen level, on the other hand, induced by either severe pruning or heavy fertilization, may result in late and uneven ripening, with the fruit more subject to pit burn.

Almonds

The almond produces its fruit largely on short spurs, although some nuts are found on one-year wood, especially in certain varieties such as the Jordan. The spur, or fruiting branch, of the almond remains economically productive for about five years.

For the sake of economy, the pruning of bearing almonds is usually restricted to the removal of limbs $\frac{1}{2}$ to $1\frac{1}{2}$ inches in diameter. Little or no time is spent in thinning out one-year shoots except to remove water sprouts, which are frequently abundant.

This practice is probably satisfactory when the pruning is annual and when conditions are such that it results in enough new growth to renew the fruit spurs continually. Approximately one-fifth of the fruit wood should be replaced each season. Trees under ten or twelve years of age can be expected to make 9 to 18 inches of new growth over the tree as a whole, older trees 6 to 10 inches.

Many old almond orchards do not make 6 inches of new growth each year, but the average production would probably be increased if—by judicious pruning, fertilizing, and irrigating—this amount of growth could be induced. To prune trees lacking in vigor, cut back the tops to large lateral limbs and thin the smaller shoots and fruiting branches.

In general, almond trees need not be thinned out quite so much as others because the foliage is rather sparse, so that light readily filters through the branches. Furthermore, the almond is seldom, if ever, pruned to prevent overbearing, since the crop is rarely heavy enough to break any of the limbs, and since the yield of the tree is more important than the size of the nuts.

Because almonds are not picked by hand, the trees need not be kept so low as other fruits. They should, however, be low enough so that all the nuts can be reached from the ground with a pole not longer than 16 feet.

On very rich soils with abundant moisture, the trees may make excessive wood growth at the age when they should come into bearing. Since pruning, except under conditions where carbohydrates are limited, tends to stimulate vegetative growth, the rational procedure in such a case is to stop pruning for a year or two.

This will tend to throw the trees into bearing and curb the heavy growth. After the bearing habit is thoroughly established, pruning may be resumed.

Apples

Apples produce most of their fruit terminally on spurs that are found on wood two years old or older. An individual apple spur frequently lives as long as 15 or 20 years, but in most orchards the period during which a spur bears often enough to be an important productive factor is not over eight or ten years.

Unfavorable weather may prevent most of the spurs from bearing in a particular year. A heavy crop will then be produced the next, and these trees will probably be thrown into the habit of alternate bearing. Certain notorious alternate-bearing varieties such as the Oldenburg, Baldwin, and Wealthy may firmly establish the alternating habit regardless of weather conditions. In California a spur often elongates and sets a terminal fruit bud the same summer it is maturing fruit, in which case the habit of alternate bearing is broken.

Although the major part of the apple crop is commonly borne on spurs, a smaller portion is produced on one-year wood, particularly with young trees of certain varieties such as the Gravenstein, Ben Davis, Jonathan, and Winesap. Varieties differ as to the part of the shoot on which the fruit is developed. Normally the fruit buds are borne either terminally or laterally near the apex. Varieties that produce an abundance of fruit buds on the one-year wood usually come into bearing at an earlier age and are more likely to bear annually than those that fruit entirely on spurs.

Thinning-out the branches to admit sufficient light to all parts of the tree is a prime consideration in causing new spurs to develop and in aiding those that already exist to bear regularly. Such thinning-out is also especially important in red-fruit varieties because abundant

light is necessary for the development of highly colored apples.

Many varieties of apples tend to overbear, especially in the alternate years, so that the fruit requires much hand-thinning. To encourage annual bearing and reduce the amount of hand-thinning necessary, prune to reduce the crop somewhat and to invigorate the trees in the alternate years when they have a heavy set of fruit buds.

The proper procedure is not only to thin shoots and branches, but also to thin out the spurs and to renew the long, many-branched ones by removing the older parts of the spurs and saving the newer—that is, to practice “spur pruning.” Particularly with reference to the fruit buds and spurs, pruning should be much lighter in the years following heavy crops, when the tree has comparatively few fruit buds.

In general, the apple does not need heavy pruning. Because it bears largely on long-lived spurs, only about 10 per cent of which must be replaced each year, it requires somewhat less new wood growth than some other fruits.

The young bearing apple tree should ordinarily make 10 to 20 inches of new wood growth each year, whereas for the older trees 6 to 10 inches is enough. This amount of new wood growth can ordinarily be secured by cutting back to laterals, leaving a few of the one-year shoots intact. If, however, the wood growth shows a tendency to drop below the minimum amounts mentioned above, heading-back the laterals that are left after thinning may be necessary to secure the proper vigor.

Apple powdery mildew, which has damaged California apple orchards considerably, particularly in the humid coast regions, can be largely controlled by proper pruning in conjunction with spraying. This means removing the diseased shoots and spurs at the regular dormant pruning and thus eliminating the sources of holdover infection. Mil-

dewed shoots are easily recognized by their gray or silvery appearance.

The undesirability of removing large limbs has already been pointed out (page 15). It is especially dangerous, however, to cut off main branches in damp coastal districts, such as the Pajaro Valley. When limbs more than 1½ inches in diameter are removed, a wood and bark disease known locally as “sappy bark” is likely to develop. This serious malady often travels down the limb from a large wound, eventually reaching the trunk and killing the tree. Disinfecting and painting the wounds has not always succeeded in preventing the disease.

Apricots

The apricot produces most of its fruit laterally on spurs that are usually not productive for more than three years. A relatively small portion of the crop is produced laterally on one-year shoots.

Since the fruit-spur system of the apricot is short-lived, the pruning treatment should be designed to cause its continual renewal. This is done by spacing branches so that new growth is encouraged along their length throughout the life of the tree (see the apricot tree illustrated on page 18). Most of this growth will be natural spur growth; more vigorous shoots may be cut back to weaker laterals to encourage spur formation. Shading, which may accompany excessive growth in the tops of the trees, reduces the replacement of spurs as they die out. Trees losing lower fruit spurs may be encouraged to develop new growth from latent buds (see illustration, page 7) by thinning out some of the upper branches.

When the tree has reached the desired height, branches are cut to laterals. This height may be maintained by annually thinning out all but one of the shoots that develop at each of these points. In the coastal areas, the shoots remaining may be headed to a few buds. In the interior districts, these shoots are left un-

cut. Considerable numbers of one-year shoots may be left throughout the tree in the interior districts to increase the bearing area. However, enough light must enter the tree to maintain fruit spurs.

Take particular care not to let the branches become too long, willowy, and unbranched. If necessary, branches should be headed at the point where branching is desired to force development of an adequate number of well-distributed branches.

As the tree becomes older, the continuance of a comparatively light system of pruning, especially in the absence of adequate soil moisture, will usually slow down the wood growth and consequently diminish the yield. A more severe type of cutting than the usual thinning may then be needed to maintain the vigor (shoot growth of 10–24 inches) of the tree.

In sections subject to brown rot, effort should be made to remove infected spurs and shoots, because these produce spores of the fungus the following spring and make control by spraying more difficult.

Sweet cherries

Sweet cherries are borne laterally on long-lived spurs that are economically productive for ten to twelve years. Because of this persistence of the fruit-spur system, the sweet cherry needs less renewal wood than almost any other deciduous fruit. If the trees have been properly trained and brought into bearing, little pruning is necessary to keep them productive. Whatever pruning is done, however, should be annual and severe enough to renew approximately 10 per cent of the fruit-bearing area each year.

As the sweet cherry tree naturally grows upright, give it as much spread as possible by retaining the outward-growing shoots and removing the upright ones. This procedure is especially important with such upright-growing varieties as the Lambert and Black Tartarian. The Royal Ann (Napoleon) naturally assumes a spreading habit with age.

Certain cherry growers have kept their trees low by doing little or no pruning during the earlier years. This results in rather precocious fruiting and allows the weight of the crops to bring about the desired spread. Careful judgment, however, must be used in following such a plan.

The cherry tree is particular about the conditions under which it will thrive: it is susceptible to drought and to excessive soil moisture. Weak trees cannot be reinvigorated by the mere adoption of a rational pruning method. To keep a bearing cherry orchard vigorous, emphasis must be laid on proper soil conditions.

When cherry trees are cut back into older wood, either to lower the trees or to stimulate wood growth, take care to cut to a lateral wherever possible. Trees showing much dieback of the outer branches can sometimes be rejuvenated by rather severe pruning. It should be stressed again, however, that soil conditions must also be improved.

Figs

Growers of the **Adriatic** and **Mission** varieties of the fig should remove annually the lower limbs that interfere with cultural practices and should administer a top pruning to remove crossing and interfering branches and sunburned or dead wood.

The pruning of bearing **Calimyrna** figs will vary with the annual amount of growth. It will consist merely of a thinning-out if the new wood growth is not excessive. If the new growth is vigorous, a thinning-out and a heading-back will be necessary. The thinning is to open the tree, whereas the heading-back (in vigorous trees) is to secure more compactness of the new fruit wood. It is perhaps advisable to cut out occasional large branches at the top of the tree rather than to stub back many smaller ones.

The **Kadota** is pruned to secure a low, spreading tree. The flat top is produced by cutting the inside branches shorter



Low-spreading Kadota trees are secured by pruning the outside branches long and the inside branches short.



than the outside ones. Each winter, cut back vigorous new branches to two or three nodes (about 4 to 6 inches), and thin to admit light to the lower branches. A low tree makes picking easier.

Terminal-bud pruning in early spring is occasionally practiced on the **Turkey** variety of fig, causing lateral fruit buds to develop earlier. Another practice with the Turkey in early districts is to prune as soon as the first crop has been harvested in order to produce new wood for a more abundant crop of late figs. In southern California, along the coast, the usual heavy winter pruning produces heavy crops.

Caprifigs are often headed back to keep the tree low so that fruits may be picked easily. Such heading is generally less severe than with the Kadota. Somewhat different methods and times of pruning are used with the different varieties of caprifigs, largely according to the time of fruiting and the amount of crop desired at a particular season.

Peaches and nectarines

The fruiting habits of nectarines and peaches are identical.

Probably no other fruit responds to proper pruning and declines with neglect as readily as the peach, largely because it bears its crop almost entirely on one-year shoots. Only occasionally is fruit found on spurs, which are very short-lived. For this reason, peach trees must be pruned more heavily than most other fruits in order to produce enough fruit-bearing wood each year. From 20 to 40 inches of growth over the tree as a whole is not excessive for young bearing trees. Older trees may be expected to produce each season an abundance of shoots from 12 to 30 inches long.

Because the foliage is dense, it is difficult to maintain a satisfactory distribution of the fruit wood in the interior of the tree. Take care to thin the trees so that adequate light may reach all parts and fruiting branches be retained on the lower limbs. If this detail is not carefully managed, the result is a "leggy" peach tree with sunburned branches and with practically all new growth confined to the outer part of the tree.

Hanging shoots and branches, sometimes called "hangers," are particularly desirable on peach trees and should be

Left, a seven-year-old Elberta peach tree before pruning. Note the vigorous new wood growth, which, however, is not excessive. This tree has been well pruned during the preceding season. On the right, the same tree after pruning by thinning-out. Note the large amount of growth removed. This tree has been pruned for four consecutive years by thinning and cutting to laterals—no cutting to stubs.



encouraged. Take care, however, to keep these from becoming too long. Frequently such shoots can be shortened and renewed by cutting back to a strong new lateral. Fruit on these hangers is borne on relatively short annual growths and sometimes on spurs.

In California a peach tree seldom fails to set enough fruit buds for a heavy crop. In fact, one perplexing problem in pruning bearing peach trees is to determine how much fruit wood should be left to blossom and mature fruit. After the superfluous larger branches have been removed and the desired form secured, the next step is to reduce the fruit buds to produce a well-distributed crop that will keep hand-thinning to a minimum.

Generally speaking, it is more economical to reduce the crop with the pruning shears during the dormant season than entirely by hand-thinning after the fruit is set. Hand-thinning, however, is necessary. An attempt to achieve desired fruit size and quality by pruning alone is likely to reduce the total tonnage so greatly as to be uneconomical.

In most instances the proper amount of fruit wood may be obtained by these steps:

1. Cut back lightly or moderately to laterals the fruiting shoots that are branched.

2. Thin out the remaining laterals on these branched shoots.

3. Thin out the unbranched one-year fruiting shoots.

Where possible, it is well to cut to the brownish, stocky laterals rather than to slender, reddish shoots; the former are better adapted to continue the framework of the tree and generally produce larger fruit.

In cutting back to a lateral that is likely to bear fruit the following season, leave a short stub just above the lateral— $\frac{1}{4}$ to $\frac{1}{2}$ inch long—to prevent the lateral from being broken off by the weight of the fruit.

Pears

In fruit bearing, the pear is almost identical with the apple, producing most of its fruit terminally on spurs. As with the apple, the productive life of an individual spur is not over eight to ten years. The pear, too, has varietal characteristics. Some varieties tend to come into bearing earlier than others. Likewise, varieties such as the Bartlett, Winter Nelis, and Angouleme under California conditions tend to produce much of their crop, especially during the early bearing years, at or near the end of one-year wood. The tendency toward alternate bearing is less pronounced, the fruit spurs are generally somewhat shorter, and the tree is more upright than the apple.

Pruning the mature bearing tree should consist primarily of removing weak wood and water sprouts, maintaining the desired height, and keeping the top of the tree open enough to admit light and permit adequate spray coverage.

As pear trees reach the desired height, the top branches should be headed to laterals. In succeeding years, shoots arising near each of these pruning cuts should be thinned to one or two.

A thinning-out of the limbs to admit light to all parts of the tree is essential for new spur development and regular bearing of existing spurs. This is particularly important in maintaining the lower branches of older trees. These branches should not be cut back to laterals, as this will progressively shorten and eventually eliminate them. The terminal shoots on these lower branches should be tipped to remove the terminal fruit buds and stimulate growth so the branch will maintain its position and not be shaded out.

Heavy pruning is not necessary. The pear bears mainly on long-lived spurs, and only about 10 per cent of them need



be replaced each year. In addition to thinning the shoots and branches, the spurs should also be thinned out. The long, many-branched spurs should be renewed by removing the older parts and saving the newer.

A system involving little or no pruning is not generally recommended. On very rich and moist soils, however, it may occasionally increase yields and decrease vegetative growth, which is susceptible to fire blight.

A well-pruned ten-year-old Glou Morceau pear tree. Note the size of the few scaffold branches, capable of supporting immense crops without breakage.

A nine-year-old Bartlett pear tree before and after pruning. This tree has been consistently pruned rather lightly. Compare with the illustration (page 43) of an adjoining tree not pruned for five years. The photographs were taken at the same distance from each tree.



Persimmons

The pruning of bearing persimmon trees should be limited to renewing the fruit wood. Since the fruit is borne on the current season's growth, thin enough to insure vigorous growth each season. Because of the general tendency toward vigorous growth, take care to thin enough to admit light; otherwise, the interior fruit wood will die, and the crop will be borne on the outer parts of the tree. This will materially decrease the potentialities of a crop and increase the danger of breakage.

Make all cuts to laterals to avoid objectionable heading or "stubbing." Water sprouts on the trunk and main branches should be removed except when needed to fill in spaces opened by breakage. Excessive cutting and stubbing result largely in the production of vigorous vegetative growth and in failure to fruit. Old neglected trees can be rejuvenated by a rather vigorous thinning and cutting back to laterals and by shortening the main branches to force out laterals where, through long neglect, all interior fruit wood has disappeared.

A nine-year-old Bartlett pear tree before and after pruning. The tree was deliberately left unpruned for the five years preceding, showing that neglected pear trees sometimes thrive, given favorable soil and moisture conditions. Note the splendid development of fruit wood and framework branches. Compare with the illustration opposite, of an adjoining tree pruned lightly. Besides increasing enormously in size, this tree has produced six to eight times as much fruit as the lightly pruned tree. This illustration is given not as a recommendation but merely to emphasize the great development secured by little or no pruning as long as the tree makes enough new wood growth.



Plums

Two general classes of plums are commercially cultivated in California—the Japanese and the European. The former includes only shipping varieties; the latter, both shipping plums and prunes. The fruiting habits and the pruning of these two classes are somewhat different.

Japanese plums are, as a rule, borne laterally upon short, thick spurs, with a minor portion of the crop borne laterally on one-year shoots. The spurs can easily be maintained throughout the tree unless an excessive number of branches is developed, in which case shading will eventually cause spurs in the lower part of the tree to die out. The life of a spur varies from five to eight years or more, but most Japanese plums produce abundant growth, making replacement a simple matter of choice of new wood.

Fruit thinning and pruning practices are closely related for Japanese plums. They usually tend to overbear, and as only the larger sizes are consistently profitable, the expensive hand-thinning is reduced by heavy pruning. Such pruning entails spur removal if much thinning effect is to be gained. Appreciable thinning by heavy pruning may not be successful with the early-maturing varieties because of the limited time for renewal of adequate leaf surface to insure good sizing of the fruit. Crop reduction, without increased size, may result.

Chemical spray thinning to regulate crop may lead to modification of the pruning of the Japanese plum varieties. In general, more small fruiting wood may be left, since pruning for thinning will be less important.

Different varieties may require different pruning practices. "Bushy" growers—those with relatively long, branched spur systems and upright spreading growth—are easily pruned by the methods described above. Low,

spreading, rather sparsely branched varieties, such as Burbank and Red Ace, may need to be cut back during training to insure adequate branching. Even after the trees come into bearing, attention must be paid to diverting the growth into the more upright branches.

The Wickson, Kelsey, and Santa Rosa, on the other hand, are examples of varieties that make a very narrow, upright growth and require careful pruning for the proper spread.

The fruit spurs of the **European plums** are longer and more slender than the Japanese and are frequently branched. Old spurs—or "fruiting brush"—may reach a length of 2 or 3 feet, whereas the spurs of Japanese plums rarely exceed 2 or 3 inches.

The pruning of European shipping plums closely resembles that of Japanese plums, but for two reasons it is less severe. Since European plums do not tend to overproduce as do the Japanese, a light pruning is sometimes necessary to favor fruit-bud formation, rather than a severe pruning to reduce the quantity of fruit buds as with the Japanese. Furthermore, a relatively larger proportion of the fruit is borne on spurs. Keeping these facts in mind, the grower may handle the European shipping plums much the same as the Japanese plum and the apricot.

There are several varietal characteristics that must be kept in mind, however. Varieties such as Pond, Giant, and to some extent vigorous President trees, need to be cut back during the training period to encourage sufficient branching. These varieties tend to grow only from the terminal bud and are very sparsely branched unless encouraged by such cutting. Tragedy, Rayburn Tragedy (Late Tragedy), Earliana, and Emilie, on the other hand, generally branch freely and present no such problem. As the spurs are long-lived, the need for constant replacement is reduced. However, too many

scaffolds left in vigorous trees may eventually result in little replacement wood through the inner and lower portions of the trees. In this case, eventually the number of spurs in these portions will be seriously reduced. Also, unless they receive enough light, the inner and lower spurs may become unproductive long before they die out.

Prunes

Mature plums that contain enough sugar to dry without fermenting are called prunes. The fruiting habit of prunes is identical with that of European shipping plums. Since, with the exception of the Sugar, Burton, and Imperial varieties, the fruit is not usually hand-thinned or picked from the tree, prune growers have not tried to keep their trees within bounds. The relation of the cost of pruning and spraying to the height of the tree should not, however, be overlooked.

Prune trees should be cut regularly, but in most cases a light thinning-out of the shoots, old spurs, and smaller branches is needed. Often the hanging branches are cut back to upward- and outward-pointing limbs to keep the tree well shaped. Fortunately, from an economical point of view, few cuts less than $\frac{1}{2}$ inch in diameter are necessary to encourage the growth of enough new wood. The terminal branches of young bearing trees should average 9 to 18 inches of growth annually. Older trees should be expected to make at least 6 inches of growth each summer. Because of its more compact fruit-spur system, the Imperial variety needs more detailed and finer pruning than is generally given the more familiar French variety.

Prune trees in California are commonly given a rather severe thinning of both the fruiting brush and the larger limbs. Often this treatment is given only

Thirty-year-old French prune tree pruned by removing a few of the larger branches and thoroughly thinning the fruiting brush.



irregularly and infrequently. Vigorous new shoots arise near the cuts, necessitating a severe pruning the following season. Two or three years may elapse before trees so heavily pruned settle down again to good production. It should therefore be re-emphasized that prune trees should regularly be given a light thinning-out.

Usually, in the older prune orchards that have received little pruning, the bearing area is a thin shell on the periphery of the tree. A branch 8 feet long, for example, often has all its fruit spurs on 2 or 3 feet at the terminal end, the rest of the branch being bare and unproductive. This concentration of the bearing area is generally caused by insufficient thinning, resulting in a shading out of the interior and of the lower fruit wood. The fruit spurs, if not killed, are often long, slender, and unproductive, in contrast with the shorter, stockier, fruit-producing spurs to be found on the outside of the tree. Such shaded, willowy spurs produce small fruit and are short-lived.

Obviously, the corrective treatment for such a condition lies in an adequate thinning-out of the smaller branches (where the tree has been properly trained), and even in the removal of a few larger branches if the framework is crowded. A word of caution is necessary. Since the prune tree is highly susceptible to sunburn, good judgment must be exercised in thinning out larger branches in the bearing trees.

The Sugar prune behaves somewhat differently from the other varieties commonly grown in California. Like the sweet cherry, it has a pronounced tendency to make most of its new growth on the tips of the previous season's shoots.

In several different localities the Sugar prune has proved to be an alternate bearer, and since the wood is brittle, the branches frequently break during the year of heavy production. In the alternate years, then, when the trees have a heavy

set of plump fruit buds, they should be pruned heavily, new shoots cut back to prevent the formation of long pole-like branches, and the fruit wood thinned out. In the off year, when the set of fruit buds is rather light, do comparatively little pruning, especially in the way of limiting fruit buds. Blossom spray thinning has helped reduce this alternating habit not only of Sugar but also of other prune varieties.

Quinces

The fruit of the quince is borne terminally on comparatively long current-season's shoots, arising from lateral and terminal buds on one-year wood. Since fruit buds are produced only on one-year wood, the grower must try to stimulate such amounts of vegetative growth that the fruit wood will be renewed annually. However, heavy production can usually be secured without a severe pruning.

Quinces sometimes continue to bear good crops of large fruit when very little pruning is done. It seems best, nevertheless, to give a pruning that will stimulate 10 to 24 inches of new growth each year on young trees and 9 to 18 inches on older ones. The pruning should be mainly a thinning-out and heading-back to laterals. Occasionally, however, it will be necessary to prune more severely to induce enough new wood.

Walnuts and Pecans

Walnut trees should be moderately pruned every year rather than severely cut at three- or four-year intervals. A pruning program for mature trees consists of four operations:

1. *Remove interfering or cross branches and weak, diseased, or dead wood.*

As the bearing walnut trees mature, the spreading branches naturally sag lower and lower and interfere with orchard operations. In commercial orchards, limbs lower than about 8 feet

from the ground should be removed in the winter. Often this means removing the tip only and cutting the branch back to an upright lateral, thus saving much fruiting wood. If a branch starts lower than 8 feet and has flattened out, it should be removed entirely.

2. Let light into the tree. Enough light should filter through the tree so that patches extend into the tree and even reach the ground. When adequate light does not reach the fruiting wood, it will produce few or no nuts and will be found weak or dead at pruning time.

A consistent program of removing each year a few branches 2 to 5 inches in diameter from the inside top of a mature tree should maintain sunlight distribution and keep inside fruit wood vigorous. The number of branches removed annually may vary from two or three to six or eight according to the size of the tree and amount of previous pruning.

3. Reduce and remove filler trees progressively. Proper pruning cannot prevent filler trees from crowding and interfering with the permanent ones. There should be a minimum of 4 to 6 feet between the perimeter of trees when their

branches are weighted down with fruit and foliage. Crowded trees shade each other, and the shaded portions become progressively weaker, produce small, poor quality nuts, and eventually die.

The trees to be removed should be pruned so as to favor and protect the permanent trees. This may be done by removing side branches, leaving the more central upright limbs to produce for several years. The permanent trees are not likely to benefit much unless half the bearing area of the temporary trees is removed. This system, if adopted several years before actual removal, will result in maximum annual tonnage.

4. Make many small cuts to invigorate. If length growth is very short (averaging 1 to 3 inches a year in coastal districts or 1 to 6 inches in interior districts) in spite of an adequate nitrogen fertilization program, pruning to stimulate more growth may be desirable. In this kind of pruning, make a large number of small cuts (300 to 500) per tree. Each cut will stimulate growth in only a small adjacent area of the tree. These cuts are made to laterals and usually in wood only 1 to 1½ inches in diameter.

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- State Dept. of Agriculture
- Teaching—School and College
- Research—Industry, University